PATENT ABSTRACTS OF JAPAN

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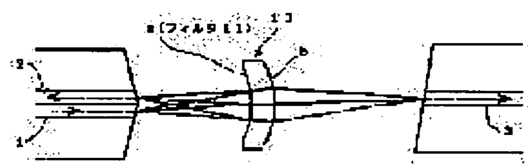
(54) OPTICAL COUPLER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an optical coupler that is simple, inexpensive, and small- sized by decreasing the number of components.
SOLUTION: Receive signal light, which is transmitted through a fiber core 1 is diffused by its end surface and refracted according to the angle of the end surface to travel upward obliquely to the right, and then reflected by a branch filter (or demultiplexing filter) 11 and a concave surface (a) of a meniscus lens upward obliquely to the left and transmitted through the concave surface (a) of the meniscus lens. The signal light, which is branched (or demultiplexed) through the concave surface (a) of the meniscus lens 10 and is reflected upward obliquely to the left is made incident on an end surface of a fiber core 2, refracted according to the angle of the end surface, and outputted along the optical axis of the fiber core 2. The signal light which is transmitted through the concave surface (a) of the meniscus lens 10 is converged by a convex surface (b), made incident obliquely on the end surface of the fiber core 3, and refracted according to the angle of the end surface of the fiber core 3, so that it is outputted along the optical axis of the bier core 3.



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CLAIMS

[Claim(s)]
[Claim 1] The optical coupler characterized by having arranged one or more fibers to the core of said convex while having the meniscus lens which has a convex with large curvature and having arranged two or more fibers in parallel to the core of said concave surface from the concave surface in which the branching filter or the spectral separation filter was formed, and this concave surface.
[Claim 2] The optical coupler characterized by cutting the end face of said fiber aslant, and for the center position of the end face biasing and arranging it from the center position of said meniscus lens in the publication of claim 1 according to a cut include angle.
[Claim 3] The optical coupler characterized by changing a convex medial axis to the medial axis of the concave surface of said meniscus lens in the bias direction from the center position of the fiber by the side of a convex in the publication of claim 2.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention distributes one wave of signal transmitted through an optical fiber in an optical transmission system or a lightwave transmission system, or relates to the optical coupler with which branching etc. carries out two or more waves of multiplexed signals.

[0002]
[Description of the Prior Art] Generally, as this kind of an optical coupler, the microoptics system constituted by optical elements, such as a lens and a half mirror, the fiber welding mold which carried out welding extension of two or more optical fiber cores, and was combined, the thin film waveguide mold, etc. are known.
[0003] Drawing 4 shows the conventional example of a microoptics system, and this optical system is constituted by three collimator lenses 5a-5c and one beam splitter 7. As a continuous line shows a lightwave signal with the configuration branched or separated spectrally, signal light which it was transmitted through the optical fiber core 1, and was diffused in the end face is made parallel by collimator lens 5a, and it penetrates a beam splitter 7 while being reflected by the beam splitter 7 subsequently (or branching). As an parallel signal light which it was condensed by collimator lens 5b as an parallel signal light reflected by the beam splitter 7 (or branching) condensed by the end face of the optical fiber core 2, and penetrated the beam splitter 7 condenses by the end face of the optical fiber core 3, it is condensed by collimator lens 5c.
[0004] Moreover, as a dotted line shows a lightwave signal with the configuration it compounds or multiplexs [configuration], signal light which it was transmitted through the optical fiber core 3, and was diffused in the end face is made parallel by collimator lens 5c, subsequently penetrates a beam splitter 7, and as it subsequently condenses by the end face of the optical fiber core 1, it is condensed by collimator lens 5a. Moreover, it is made parallel by collimator lens 5b, and subsequently is reflected by the beam splitter 7, and as the signal light which it was transmitted through the optical fiber core 3, and was diffused in the end face subsequently condenses by the end face of the optical fiber core 1, it is condensed by collimator lens 5a.
[0005] Drawing 5 shows other conventional examples and optical fiber core 4 and collimator lens 5d is added. And signal light which it was transmitted through the optical fiber core 4, and was diffused in the end face is made parallel by collimator lens 5d, and it penetrates a beam splitter 7 while being reflected by the beam splitter 7 subsequently (or branching). As an parallel signal light which it was condensed by collimator lens 5c as an parallel signal light reflected by the beam splitter 7 (or branching) condensed by the end face of the optical fiber core 3, and penetrated the beam splitter 7 condenses by the end face of the optical fiber core 2, it is condensed by collimator lens 5b.
[0006]
[Problem(s) to be Solved by the Invention] However, in the optical coupler of the microoptics system concerning the conventional example mentioned above, since many optical elements of collimator lenses 5a-5d or beam splitter 7 grade were needed, association between each optical element containing the optical fiber cores 1-4 was not easy, and since 90 degrees of optical paths were bent, there were enlargement and a problem of becoming expensive.
[0007]
[Means for Solving the Problem] Suppose it that a branching filter or a spectral separation filter is formed in the concave surface of a meniscus lens, and signal light is branched or separated spectrally while a meniscus lens with convex larger curvature than a concave surface is used for this invention. By this configuration, since the light diffused in the end face of a fiber core can be condensed by the convex of a meniscus lens, a condenser lens can be omitted, therefore components mark can be decreased, and simplicity and a cheap and small optical coupler can be realized.
[0008]
[Embodiment of the Invention] In the optical coupler of this invention, from the concave surface in which the branching filter or the spectral separation filter was formed, and this concave surface, while having the meniscus lens which has a convex with large curvature and having arranged two or more fibers in parallel to the core of said concave surface, one or more fibers have been arranged to the core of said convex.
[0009] Although an end face is able to use the fiber which is not cut aslant as said fiber, if the center position of the end face biases and is arranged from the center position of a meniscus lens according to the cut include angle using the fiber with which the end face was cut aslant,

the return light in the end face of a fiber can be prevented.
[0010] Moreover, if a convex medial axis is changed to the medial axis of the concave surface of said meniscus lens in the bias direction from the center position of the fiber by the side of a convex, loss of the joint effectiveness by aberration can decrease and branching of low loss and spectral separation can be realized.
[0011]
[Example] When an example is explained with reference to a drawing, drawing 1 is the block diagram showing the optical coupler concerning the 1st example of this invention. The optical coupler concerning this example is constituted by the meniscus lens 10 which carries out optical coupling of between 2 heart fiber (1 2) which has the fiber core 2 which outputs the fiber core 1 and sending-signal light which input-signal light inputs, 1 heart fiber 3 for outputting sending-signal light, and 2 heart fiber (1 2) and 1 heart fiber 3.
[0012] A meniscus lens 10 has a concave surface a and Convex b, dielectric multilayers are formed in a concave surface a, and the branching filter (or spectral separation filter) 11 is formed. moreover, the refractive power of Convex b is stronger than a concave surface a (curvature is) -- it is formed like, therefore this meniscus lens 10 very thing is a positive lens (convex lens). Moreover, the concave surface a and Convex b are formed so that each medial axis may be in agreement.
[0013] Furthermore, each end face of the fiber cores 1-3 is cut aslant. The end face of the fiber cores 1 and 2 is formed in convex so that the light which carried out incidence of the light refracted in detail when carrying out outgoing radiation by the end face of the fiber core 1 in drawing 1 to the end face of the fiber core 2 from the diagonal below toward the diagonal right may be refracted by the end face and it may tend toward the shaft orientations of the fiber core 2. Moreover, the light which carried out incidence to the end face of the fiber core 3 from the diagonal below is arranged so that it may be refracted by the end face and may tend toward the shaft orientations of the fiber core 3. And the core biases and the meniscus lens 10 is arranged so that incidence may correspond aslant and the optical axis of light may correspond to the fiber cores 1-3 as mentioned above, in case outgoing radiation is carried out.
[0014] In such a configuration, the input-signal light transmitted through the fiber core 1 penetrates the concave surface a of a meniscus lens 10 while it is refracted according to the include angle of the end face while being spread in the end face, and branching with the filter 11 of the concave surface a of a meniscus lens 10 subsequently toward the diagonal right (or spectral separation) and being reflected in the diagonal left. Incidence of the signal light which branched by the concave surface a of a meniscus lens 10 (or spectral separation), and was reflected in the diagonal left is carried out to the end face of the fiber core 2, it is refracted according to the include angle of the end face, and is outputted in the direction of an optical axis of the fiber core 2. Moreover, it is condensed by Convex b, and incidence of the signal light which penetrated the concave surface a of a meniscus lens 10 is carried out to slanting above one to the end face of the fiber core 3, it is refracted according to the include angle of the end face of the fiber core 3, and is outputted in the direction of an optical axis of the fiber core 3. Therefore, according to such a configuration, since it is constituted by only the fiber cores 1-3 and the meniscus lens 10, it can decrease and components mark can be constituted in simplicity, cheapness, and small.
[0015] Next, the 2nd example is explained with reference to drawing 2 . This optical coupler is constituted [both] by the meniscus lens 10 which carries out optical coupling of between these fiber cores 1-4 to 2 heart fiber (1 2) which has the fiber cores 1 and 2 which sending-signal light and input-signal light output and input, and 2 heart fiber (3 4) which has the fiber cores 3 and 4 which both sending-signal light and input-signal light similarly output and input. In this 2nd example, 2 heart fiber (1 2) and a meniscus lens 10 are the same configurations as the 1st example, and the arrangement location of the fiber core 3 is also the same. And from a meniscus lens 10, the core of the fiber core 4 is biased caudad, and is arranged, and the end face is formed in convex by 2 heart fiber (3 4) like 2 heart fiber (1 2).
[0016] In such a configuration, toward the diagonal right, while being spread in the end face, it is refracted according to the include angle of the end face, and subsequently the signal light

transmitted through the fiber core 1 branches with the filter 11 of the concave surface a of a meniscus lens 10 (or spectral separation), and it penetrates the concave surface a of a meniscus lens 10 while being reflected in the direction of the diagonal left. Incidence of the signal light which branched by the concave surface a of a meniscus lens 10 (or spectral separation), and was reflected in the direction of the diagonal left is carried out to the end face of the fiber core 2, it is refracted according to the include angle of the end face, and is outputted in the direction of an optical axis of the fiber core 2. Moreover, it is condensed by Convex b, and incidence of the signal light which penetrated the concave surface a of a meniscus lens 10 is carried out to slanting above one to the end face of the fiber core 3, it is refracted according to the include angle of the end face of the fiber core 3, and is outputted in the direction of an optical axis of the fiber core 3.

[0017] Moreover, the signal light transmitted through the fiber core 2 penetrates the concave surface a of a meniscus lens 10 while it is refracted according to the include angle of the end face while being spread in the end face, and branching by the concave surface a of a meniscus lens 10 subsequently toward the diagonal below (or spectral separation) and being reflected in the direction of the diagonal below. Incidence of the signal light which branched by the concave surface a of a meniscus lens 10 (or spectral separation), and was reflected in the direction of the diagonal below is carried out to the end face of the fiber core 1, it is refracted according to the include angle of the end face, and is outputted in the direction of an optical axis of the fiber core 1. Moreover, it is condensed by Convex b, and incidence of the signal light which penetrated the concave surface a of a meniscus lens 10 is carried out to slanting down one to the end face of the fiber core 4, it is refracted according to the include angle of the end face of the fiber core 4, and is outputted in the direction of an optical axis of the fiber core 4.

[0018] Moreover, while it is refracted according to the include angle of the end face while diffusing the signal light transmitted through the fiber core 3 in the end face, and it is subsequently condensed by the convex b of a meniscus lens 10 toward the diagonal below, branching by the concave surface a subsequently toward the diagonal left (or spectral separation), being reflected, being condensed by Convex b and going to the diagonal below, the concave surface a of a meniscus lens 10 is penetrated. Incidence of the signal light which branched by the concave surface a of a meniscus lens 10 (or spectral separation), was reflected, was condensed by Convex b, and went to the diagonal below is carried out to the end face of the fiber core 4, it is refracted according to the include angle of the end face, and is outputted in the direction of an optical axis of the fiber core 4. Moreover, incidence of the signal light which penetrated the concave surface a of a meniscus lens 10 in the direction of the diagonal below is carried out to the end face of the fiber core 1, it is refracted according to the include angle of the end face, and is outputted in the direction of an optical axis of the fiber core 1.

[0019] Moreover, while it is refracted according to the include angle of the end face while diffusing the signal light transmitted through the fiber core 4 in the end face, and it is subsequently condensed by the convex b of a meniscus lens 10 toward the diagonal left, branching by the concave surface a subsequently toward the diagonal left (or spectral separation), being reflected, being condensed by Convex b and going to the diagonal right, the concave surface a of a meniscus lens 10 is penetrated. Incidence of the signal light which branched by the concave surface a of a meniscus lens 10 (or spectral separation), was reflected, was condensed by Convex b, and went to the diagonal right is carried out to the end face of the fiber core 3, it is refracted according to the include angle of the end face, and is outputted in the direction of an optical axis of the fiber core 3. Moreover, incidence of the signal light which penetrated the concave surface a of a meniscus lens 10 in the direction of the diagonal left is carried out to the end face of the fiber core 2, it is refracted according to the include angle of the end face, and is outputted in the direction of an optical axis of the fiber core 2.

[0020] By the way, in this kind of optical coupler, when optical coupling of between configuration members is carried out, it is required that loss should be small. However, with the configuration shown in drawing 1 , since the aberration of a surrounding beam of light becomes large among the light emitted from the end face of the fiber core 1, some loss occurs.

[0021] Then, while making the medial axis of the concave surface a of a meniscus lens 10 in

agreement with the core CL of the fiber cores 1 and 2, the medial axis of the convex b of the aspheric surface is made to bias in the 3rd example shown in drawing 3 between the core CL of the fiber cores 1 and 2, and the core of the fiber core 1. That is, if the core CL of d and the fiber cores 1 and 2 and the pitch of the fiber core 1 are set to dC for the amount of bias of the medial axis of the convex b to the medial axis of the concave surface a of a meniscus lens 10, these can decrease 0<d<dC and loss of the joint effectiveness by aberration if it is in the relation between d=dC/2 ideally.
[0022]
[Effect of the Invention] This invention is carried out with a gestalt which was explained above, and does so effectiveness which is indicated below.
[0023] Since it constituted so that a branching filter or a spectral separation filter might be formed in the concave surface of a meniscus lens and signal light might be branched or separated spectrally into it while using the meniscus lens with convex larger curvature than a concave surface, a condenser lens can be omitted, components mark can be decreased and simplicity and a cheap and small optical coupler can be realized.
[0024] Moreover, if the center position of the end face biases and is arranged from the center position of a meniscus lens according to the cut include angle using the fiber with which the end face was cut aslant, the return light in the end face of a fiber can be prevented.
[0025] Moreover, if a convex medial axis is changed to the medial axis of the concave surface of said meniscus lens in the bias direction from the center position of the fiber by the side of a convex, loss of the joint effectiveness by aberration can decrease and branching of low loss and spectral separation can be realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the optical coupler concerning the 1st example of this invention.
[Drawing 2] It is the block diagram showing the optical coupler concerning the 2nd example of this invention.
[Drawing 3] It is the block diagram showing the optical coupler concerning the 3rd example of this invention.
[Drawing 4] It is the block diagram showing the conventional optical coupler.
[Drawing 5] It is the block diagram showing other conventional optical couplers.
[Description of Notations]
1-4 Fiber core
10 Meniscus Lens
11 Filter
Concave surface
b Convex

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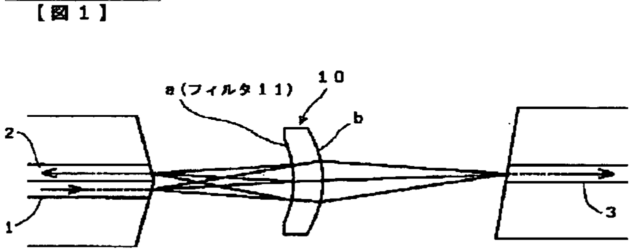
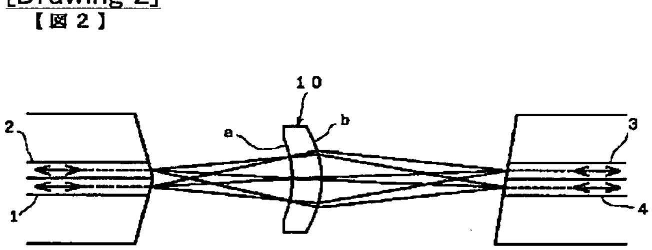
DRAWINGS

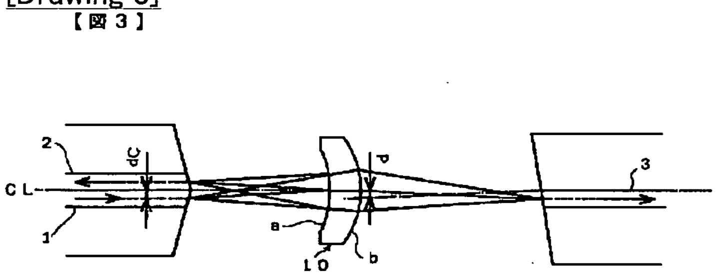
[Drawing 1]



[Drawing 2]

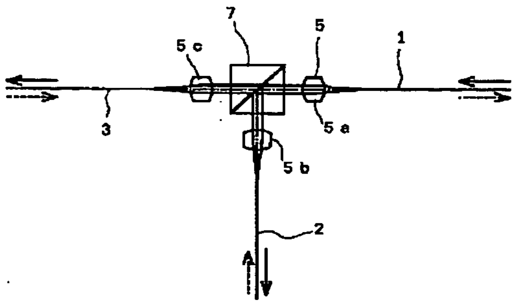


[Drawing 3]

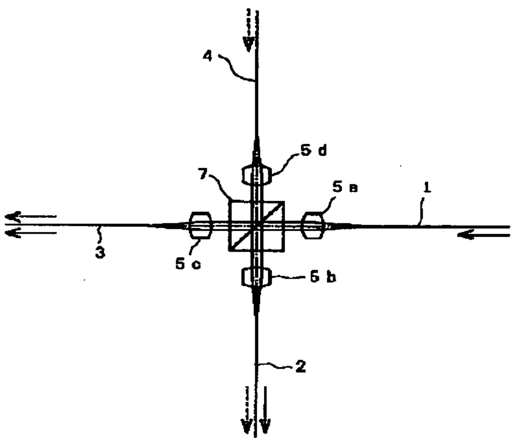


[Drawing 4]

【図４】



[Drawing 5]
【図５】



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